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A Techno-Petrographic Approach for Defining Cultural Phases and Communities: Explaining the Variability of Abu Hamid (Jordan Valley) Early 5th Millennium cal. BC Ceramic Assemblage

Valentine Roux, Marie-Agnès Courty, Geneviève Dollfus, Jaimie L. Lovell

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9. A Techno-Petrographic Approach for Defining Cultural Phases and Communities: Explaining the Variability of Abu Hamid (Jordan Valley) Early 5th Millennium cal BC Ceramic Assemblage

Valentine Roux, Marie-Agnès Courty, Geneviève Dollfus and Jaimie L. Lovell

Introduction

In archaeology, the term ‘culture’ encompasses two main concepts: a ‘cultural phase’ and a ‘cultural group’. The first concept, also called a chrono-cultural complex, cultural horizon or tradition (Gopher and Gophna 1993), is proper to archaeology. It defines a period of time characterized, in a certain area, by recurring assemblages of artefacts, marked by a beginning and an end, and affecting different domains (material culture, economy, sociology, religion, natural resources) (Clarke 1978; Renfrew 1972). The second concept derives from anthropology and refers to sociological entities whose definition varies according to the scale of observation (*e.g.*, Stark 1998). Contrary to the old belief that cultural phases are monolithic and represent homogenous social entities, recent research, particularly in the domain of technology, indicates that a cultural phase, as defined above, can include different socio-cultural groups, interacting at a certain level but characterized by diverse assemblages (*e.g.*, technological variability within the Beer Sheva–Ghassulian tradition). The more a period comprises socio-cultural entities that differ from each other in terms of material culture, the more difficult it is to characterize a ‘cultural phase’ and to assign assemblages to that phase. This is particularly pertinent to transitional periods, which are often marked by a wide variability of stylistic features at the macro-regional level. If variability is analysed in terms of presence and absence by reference to type fossils (Philip and Baird

2000), as when seeking to assign assemblages to periods such as the Late Neolithic–Chalcolithic, intense debates may follow (Banning 2002; Gopher and Gophna 1993; Gilead 1990; Lovell *et al.* 2004).

The oft-proffered solution to correlating such assemblages is to refine both the typological links and the radiocarbon sequences in order to clear up the chronological discrepancies and enable us to assign each assemblage to a given period (Banning 2002; 2007; Lovell *et al.* 2007). The problem with this approach is twofold. Firstly, it presupposes that a ‘cultural phase’ will include assemblages with close typological links – that is, the repertoire will exhibit a certain degree of formal homogeneity. However, one should consider the fact that a cultural phase can comprise, on the synchronic axis, assemblages quite different from one another, representing the coexistence of various different groups standing apart from each other, even though interacting; and, on the diachronic axis, assemblages originating from the same cultural group but presenting morphological and/or stylistic variability due to evolution over time (*e.g.*, Mayor 1994). Secondly, when radiocarbon assays are analysed carefully in the light of the stratigraphic sequence (Banning 2002; 2007; Lovell *et al.* 2007; Manning 2007), they can date a cultural phase. However, given methodological constraints, they can rarely be used to precisely estimate the temporal relationship between different short-lived sequences (Banning 2007; Burton and Levy 2001). It

follows that it is difficult, on the basis of dates alone, to correlate assemblages at a macro-regional level.

In order to define both cultural phases and cultural groups, we suggest here that the techno-petrographic approach holds great heuristic value. This approach combines analysis of ceramic assemblages in terms of both technological traditions and clay fabrics (Roux and Courty 2005; 2007). These combined data express the technical behaviours reproduced by social entities in landscapes made up of material resources that evolve over time. Active landscapes, continuously shaped by environmental processes, offer the great advantage of displaying significant environmental changes at more or less similar time scales as cultural changes. In addition to the record provided by high resolution soil-sedimentary sequences, the effects of environmental changes can also be traced in well-stratified archaeological contexts by significant modifications of anthropogenic materials collected from various natural sources (Courty 2001). This direct reading of environmental changes in archaeological sequences thus allows a correlation with cultural periods which is independent of radiometric dating. As a consequence, an integrated study of clay materials and technical behaviour, within a high-resolution temporal frame, offers great potential for assigning ceramic assemblages both to cultural phases and cultural groups.

The techno-petrographic approach is applied here to the Abu Hamid ceramic assemblage. Abu Hamid is located in the central Jordan valley. It has provided a long occupation sequence dated from the middle of the 6th to the late 5th/beginning of the 4th millennium cal BC (Dollfus and Kafafi 1988; 1993; Lovell *et al.* 2007). In this paper we propose to analyse the ceramics belonging to Phase II (*i.e.*, levels 3a–e, dated to the first half of the 5th millennium). These precede Phase III, which is allocated to the same relative chronological horizon as the Beer Sheva–Ghassulian tradition on the basis of the presence of ‘classic’ cultural features (*e.g.*, wheel-shaped bowls, violin figurines, stone and hematite maceheads, basalt bowls, fenestrated vessels, churns and so on; Dollfus and Kafafi 1988). The objective is, firstly, to characterize the period prior to the Beer Sheva–Ghassulian tradition, which remains the subject of much debate as a result of the variability of ceramic assemblages assigned to the so-called ‘Middle Chalcolithic’ phase and the discrepancy of dates (Blackham 2002; Garfinkel and Miller 2002; Kafafi 2001; Kerner 2001; Lovell 2001); and, secondly, to assess the diversity of the cultural groups that have occupied the Jordan valley during this period.

Before presenting and discussing our results we elaborate on the importance of the techno-petrographic approach for highlighting cultural phases and groups, and present the archaeological context and the methodology followed.

The techno-petrographic approach

The techno-petrographic approach consists of classifying

ceramic assemblages according to a hierarchical order that distinguishes technological, petrographic and morpho-stylistic groups, in that order, in relationship to one another (Roux and Courty 2005). We use the term ‘techno-petrographic’ because it emphasizes the specific sorting we use, as distinct from the traditional sorting where vessels are classified first according to shape or fabric (or a combination of both). Morpho-stylistic groups are defined on the basis of both morphological and decorative attributes. The techno-petrographic classification aims to highlight techno-petrographic groups that correspond to particular *chaînes opératoires* – that is, a sequence encompassing the different operations according to which raw material is transformed into a finished product (Creswell 1996). Techno-petrographic groups recurring over time correspond to distinct traditional *chaînes opératoires*. They are considered to be particularly relevant criteria by which to identify social groups because of the universals pertaining to the mechanisms of learning and transmission of technical tasks (Roux 2007). These mechanisms come into play at the individual and collective level.

At the individual level, any cognitive or motor skill is learned through apprenticeship according to a model. In other words, apprentices learn according to what the master shows or teaches. They never learn by inventing, whatever the context of apprenticeship (Bril 2002). When there is ‘invention’ in the process of learning it does not affect the technique, the method or the related skills, only the different values a technical operation can take, and these do not imply new specific skills (*e.g.*, invention in painting design, Dietler and Herbich, 1998). At the end of the apprenticeship process the skills necessary for reproducing the tradition, and only these skills, are literally ‘embodied’. These skills then participate directly in the maintenance of the tradition, in the sense that it becomes difficult for the subject to foresee the making of things according to ‘other ways’, because the cognitive and motor skills they have developed then act as ‘fixers’ of world views. In other words, a technical tradition is reproduced through the apprenticeship process, and this fixes the tradition at the individual level.

Individuals are part of social groups (of whatever size or nature). At the collective level these groups ensure the reproduction of the tradition through transmission networks, understood here as networks favouring vertical and/or horizontal transmission. Distinct transmission networks express social boundaries that can correspond to different social entities: ethnic and ethno-linguistic groups, class, caste, tribe, gender and so on (*e.g.*, Degoy 2006; Dietler and Herbich 1998; Gallay 2007; Gosselain 2000; Livingstone Smith 2000; Shennan 1989; Stark 1998). The fact that different technical traditions exist side by side indicates, primarily, that the apprenticeship process took place within different social groups, or else within different ‘communities of practice’, a term coined by Lave and Wenger (1991) that refers to social groups who have ‘the same way of doing things’. Such a concept is appropriate

because it does not refer to a specific social entity, but instead to the community within which a technical tradition takes place (for use of this concept in ethnoarchaeology, see Gosselain 2008). Depending upon contextual and/or spatio-quantitative data, such communities can, in some cases, be interpreted more precisely – for example, in ethnic terms (Gallay 2007).

By definition, techno-petrographic traditions endure for a certain span of time, even though these traditions can present a certain degree of variability given continuous evolution over time (e.g. Shennan and Wilkinson 2001). From one period to another the material resources can remain stable or change simply as a result of triggers independent of cultural factors. The synchrony between changes in technological traditions and changes in material resources provides an ideal use of the clay fabric itself as a relative time marker of successive chrono-cultural periods with distinctive techno-petrographic traditions. This is most effective when exploitation is of clay resources from superficial soils that have been constantly reactivated by geomorphic changes. This is the case in the southern Levant, as shown by extensive palaeogeographical studies (Courty 1994; Hourani and Courty 1997). As a consequence, the southern Levant in the 5th millennium cal BC offers an ideal context to test the potential of the techno-petrographic approach for characterizing the ceramic assemblages belonging to the phase prior to the Beer Sheva–Ghassulian horizon.

Chrono-cultural context

The Abu Hamid sequence has been divided in three main phases on the basis of stratigraphy (Dollfus and Kafafi *et al.* 1993; Lovell *et al.* 2007). Radiocarbon assays provide absolute dates for the levels containing artefacts related respectively to the Beer Sheva–Ghassulian horizon (Phase III), the Wadi Rabah horizon (Phase II) and the Late Neolithic (Phase I). Phase I, levels 5–4, is dated to the end of the 6th millennium/beginning of the 5th millennium cal BC; phase II, levels 3a–e, is dated to the early–mid 5th millennium cal BC; phase III, levels 2–1, is dated to the late 5th/early 4th millennium cal BC (Lovell *et al.* 2007).

The techno-petrographic study has been conducted on the ceramics belonging to Phase II (levels 3a–e). Phase II has been recognized in the northern area of the site over 300 m², and in the south over 250 m². Architectural structures reveal houses characterized by rectangular rooms with hearths, platforms and small storage rooms; in the courtyards, small pits – both firing pits often filled with stones and plastered/clay-coated basins – have been excavated. The excavators associated the ceramic material from Phase II with the Wadi Rabah assemblage, as defined by Kaplan (1958, 1972), on the basis of the burnished and impressed ware (Dollfus and Kafafi *et al.* 1993, 254).

Methodology

Corpus

From levels 3a–e 15,485 sherds have been collected, of which 9697 come from reliable stratigraphic contexts. These have been the subject of a typological analysis (Lovell *et al.* 2007). The techno-petrographic study was carried out on a total of 933 sherds considered exemplars of significant morphological and/or stylistic attributes (as selected by Jaimie Lovell). Of these, about 400 formed the basis of a technological study. Half of these were subjected to petrographic examination. The results presented here bear on 175 sherds that were selected on two criteria: the legibility of their surface features and their possible interpretation in terms of manufacturing technique; and the integrity of their archaeological context. The majority of these sherds belong to levels 3a and 3b. Our observations on the diversity and variability of surface features and fabrics during phase II were later tested by the random sampling of body sherds.

Technological analysis

A technological analysis is aimed at the identification of technological groups – that is, groups of sherds presenting recurrent technological practices and, in this regard, representative of communities. By definition, each vessel is the output of a technological practice. Therefore, study of technological practices seeks to examine each vessel in terms of manufacturing techniques, tools, gestures, quality and ‘know-how’. For this purpose, surface features, visible on both the outer and inner faces of the clay walls, are recorded. Manufacturing techniques and tools are identifiable on the basis of diagnostic attributes highlighted as such by experimental and/or ethnoarchaeological studies (e.g., Roux and Courty 1998; Gelbert 2003; Ali 2005; Rye 1981); gestures are indicated by the orientation of the visible forming and/or finishing surface features; quality is expressed by the surface aspect of the clay walls; ‘know-how’ is suggested by the regularity of the wall and rim morphology.

Petrographic analysis

Petrographic examination under the binocular microscope commences with an estimate of the petrographic variability within, and between, each technical group. At the same time the petrographic variability is considered against the landscape context, which is now well understood from previous palaeogeographical studies (Hourani and Courty 1997; Hourani 2002). Extensive survey of soil landscapes formed during the 6th–4th millennia cal BC in the southern Levant and nearby regions has allowed us to identify a gradual change from highly humid conditions with extensive swamps along flood plains at the beginning of the second Holocene optimum to more concentrated

rainfall, higher temperature, and a more incised landscape due to a significant erosional increase (Hourani and Courty 1997; Hourani 2002). Clay-rich materials, preferentially collected for ceramic fabrication in low-lying depositional and flood-plain basins, are therefore directly reflecting this palaeoenvironmental evolution. Clay materials with a higher clay content and with clay-fabrics typical of waterlogging are expected to be dominant in the ceramic assemblage of the 6th millennium. Samples with high clay content and pedogenic fabrics typical of soil stabilization can be associated with sources exploited during the phase prior to the Beer Sheva–Ghassulian phase. For this latter phase the greater proportion of coarse components resulting from repeated surface runoff is expressed in local to micro-regional specificities. This means that identification of clay provenance at a micro-regional and regional level for the 6th- to 5th-millennium cal BC ceramic assemblage in the Near East requires greater subtlety when compared with the transition from the 5th–4th millennia cal BC, which is more clearly defined owing to a more highly contrasted mosaic of landscapes. At this stage of the techno-petrographic study, the variability observed for the 5th-millennium ceramic assemblage cannot, therefore, be directly elucidated in terms of distinctive provenance. This would require an extensive study of the soil landscapes of the period, which is beyond the scope of the research presented here.

Results

The technological groups

The ceramic assemblage belonging to Phase II Abu Hamid is both highly diverse and homogeneous, depending on the scale of observation. The diversity is expressed mainly at the level of the finishing operations and the quality of the finished product. Homogeneity is expressed at the level of the forming technique. All of the vessels (large or small, open or closed) are made by coiling. The coils are progressively joined on the inner face either with fingers (uneven surfaces) or hard tools (even surface).

The finishing operations encompass the surface treatment operations aimed at regularizing the clay walls, and the decoration operations. The studies of surface treatment allow us to identify two main groups of vessels, *A* and *B*. In the former, after the rim has been fashioned and the pot partially dried, the external face of the body is coated with clay paste and then smoothed with a tool or with the moistened palm of the hand. The result is a surface with a lumpy aspect created by the coarse fraction of the coating applied on the leather-hard clay walls. The coarse fraction is covered by a thin clay layer created while smoothing the external walls with a moistened tool/hand. After a drying stage, slip, red painting or decoration (impressed, appliqué) can follow.

Variations in the lumpy aspect of the external clay wall suggest different ways in carrying out the surface

treatment. These variations are expressed according to the following descriptive parameters: prominence of the coarse fraction – differences in the prominence of the coarse fraction indicates differential use of water when smoothing the clay walls; coating of clay – the coating of clay over the coils can be homogeneous or heterogeneous; striations on the external walls – the morphology and orientation of the striations indicate differences in the tools used for smoothing the external wall as well as different smoothing gestures.

The inner clay walls of vessels *A* are regularized either with the fingers or a hard tool while still humid. As a result, the coarse fraction is uncovered though damped into the clay (it is not prominent, contrasting with the external faces). When it has been smoothed with the fingers the aspect of the clay wall is slightly lumpy.

The surface treatment of Vessels *B* is carried out on humid clay. It consists of regularizing the clay walls either with fingers or with a hard tool. Finishing with fingers is achieved either with or without the use of a rotary movement. Use of a rotary movement is suggested by concentric parallel striations visible on the rim and upper part of the vessels. These striations are edged by rillings formed when adding water to regularize the clay walls while the pot was rotating. The rotary movement may have been achieved with an instrument rotating, or not, around an axis. Surface treatment on humid clay can be followed by decoration operations either on humid clay (impressed or incised decoration), or on leather-hard clay (application of a red slip which may or may not be burnished).

Vessels A

The vessels finished with surface treatment *A* present three main fashioning qualities which distinguish three groups of vessels: low-quality vessels *A1*, medium-quality vessels *A2* and higher-quality vessels *A3*. These qualities of vessel have been differentiated on the basis of the following technological attributes: the microtopography of the clay walls (from extremely uneven, bumpy, with fissures and cracks to even surfaces with no flaw), the regularity of the rim and the body (regular or irregular) and the prominence of the lumps (low, medium, high) (Table 9.1). These attributes reflect the know-how of the potters as well as the care taken in the course of the

Uneven microtopography		A1
Even microtopography	Irregular morphology	A2
	Regular morphology	
		Prominence Low
		A3

Table 9.1 Classification of the vessels belonging to the technological group *A* on the basis of their quality of fashioning

manufacturing process. Within each of these three groups there is a strong variability in the values of the parameters describing the fashioning or finishing operations. These values are on a continuum which means that these groups can also overlap.

LOW-QUALITY VESSELS – A1

The low-quality vessels (Figure 9.1) represent 29% of our corpus (Table 9.2). They are mainly characterized by uneven, bumpy clay walls, irregular rims, major faults such as drying cracks or fissures, and external faces with a strong lumpy aspect. The coarse fraction is prominent, covered unevenly by a clay slip whose differential thickness creates uneven surfaces. Visible striations, following either a horizontal or a vertical direction, indicate the smoothing of the external wall with the hand or a soft tool.

Despite these common technological features, there is also a certain variability expressed:

- in the visible properties of the fabric – the colour of the clay and the colour, size and quantity of the coarse fraction;
- in the treatment of the inner face, which can be smoothed either with the fingers or with a tool;
- in the unevenness of the superficial layer of the external clay wall, owing to different degrees of care in the coating process;
- in the degree of irregularity of the vessels, originating from the forming stage or the finishing stage, while smoothing the clay walls;
- in the faults of the vessels: some vessels present fissures, others drying cracks, others traces of joins of coils.

The range of decoration is quite limited. Most of the low-quality vessels present no decoration. However, some present a red slip or red bands on outer and inner rim and/or horizontal or oblique red bands on the body. Blackish-grey firing traces are present on most of the vessels on the body or next to the rim.

The low-quality vessels include large and small open and closed vessels. They are bowls, basins, holemouth jars and jars. Each morphological category includes different

types characterized by the orientation of the walls (straight or rounded) and the shape of the rims (Table 9.3). Vessels *A1* are distributed in the different levels of Phase II.

MEDIUM-QUALITY VESSELS – A2

Medium-quality vessels (Figure 9.2) represent 39% of our corpus (Table 9.2). They present clay walls that are more even than those of vessels *A1*. They are not bumpy, reflecting more care or more know-how at the forming stage. The lumpy aspect is less prominent and more homogeneous, suggesting more control in the coating and/or smoothing operations. However, morphological features such as rims are not all regular, reflecting some awkwardness in the fashioning process. Variability within this group is much stronger than within *A1*. It can be described in terms of the visible properties of the fabric, the density of the network of the lumps (which can be more or less tight) and, lastly, the covering of the coarse fraction (which can be partial or complete). The inner faces are smoothed either with a hard tool or with fingers.

Most of these vessels present a red slip and/or red bands on outer and inner rim and/or a red wash decoration (less than half of the vessels are not slipped). Some of the non-slipped vessels present an impressed or an applied decoration. Some vessels present firing traces.

The morphological categories include bowls, basins, holemouth jars and jars of different dimensions and types (straight or rounded walls, rims of different shapes) (Table 9.3). Vessels *A2* are distributed in the different levels of Phase II.

HIGHER-QUALITY VESSELS – A3

The higher-quality vessels (Figure 9.3) constitute 23% of our corpus (Table 9.2). These vessels present regular, even clay walls, reflecting care at the forming and finishing stage. The external walls are hardly lumpy; the coarse fraction does not stand out and is covered evenly by a clay layer despite the fact that it remains important either in size or in quantity. The inner faces are finished either with a hard tool or with fingers. Most of the so-called higher-quality vessels have received a uniform red slip,

<i>Corpus</i>	<i>Total</i>	<i>Group A1</i>	<i>Group A2</i>	<i>Group A3</i>	<i>Group B</i>
2/3a	17	3	7	5	2
3a	78	26	28	17	7
3b	31	11	13	3	4
3c	20	6	8	4	2
3d	8	1	3	3	1
3e	6	1	3	2	
3-	6		3	2	1
Transitional 3/4	9	2	3	4	
Total	175	50	68	40	17

Table 9.2 Number of vessels from phase II according to technological groups and stratigraphic level

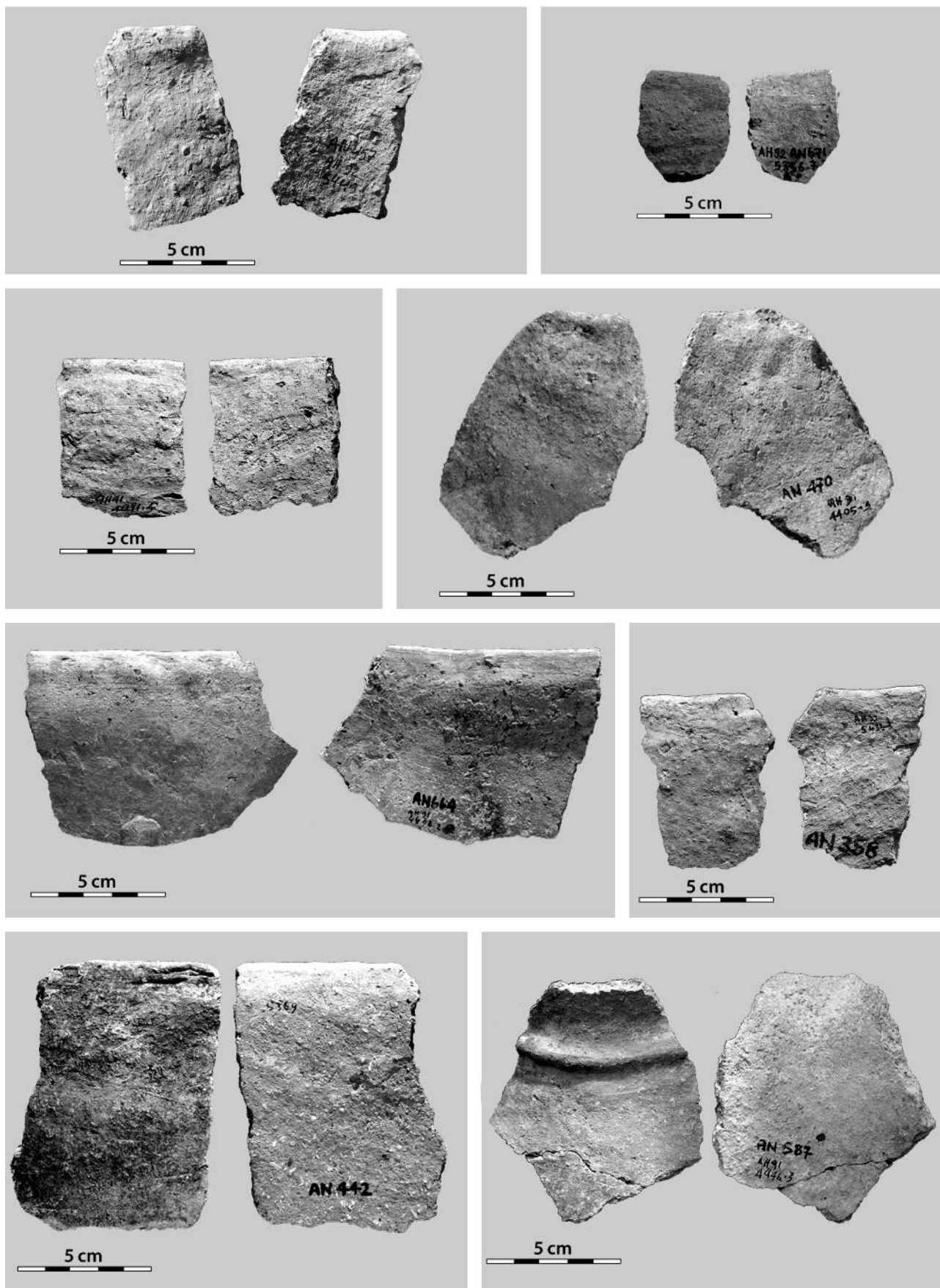


Figure 9.1 Low quality vessels – A1

Stratigraphic level	Vessels A1	Vessels A2	Vessels A3
2/3a	B2a2	A1a7 B1a1	A1b5, A2b2
	D2b3	D2b3, D2b7, D1b2 E2a5	D1c2 H1b
3a	A1a4, A2b3	A1b2, A1b3, A1b5, A1c2, A2b2, A2b3	A1b2, A1c2
	B1A7 D1a1, D1a3, D1a5, D1b2, D1b3, D1c2, D2a6, D2b1, D2c2,	D1a6, D1c3, D2b2, D2b3, D2c2, D2c6, D3	D1a1, D1c5, D1c7
	E1b5, E1b2, E3	E1a3, E1a5, E1b2, E1c3, E2a3	E1a5, E1b5, E1e5 E2a2, E2e3
3b	A1a5, A1b3	A1b2, A1b3, A1b5, A2b2, A2b4 B2a1	C3 D1c5 E1a3
	D1c3, D1a5, D2c6 E2d7	D1c4	
3c	D1c3, D1c5, D2c3, D2c5	A1b2, A1c1 E1a3, E1e5 H1c J3	A1c1 D1c3, D2b1
3d	D2c4	A1b2 E2a3	A1b2 E1a2
3e	A2c1 D1c3	E1a3, E2b5	D1c2 E1a2
3/4		D1c3 E1a5 H1g	A2b2, A1b5 D1c2 H1b

Table 9.3 Distribution of morphological types among the different ceramic groups A. (A = bowl, B = basin, C = churn, D = holemouth, E = jars, H = base, J = platter; 1 = straight-sided, 2 = round-sided; the full morphological codes correspond to those published in Lovell et al. 2007)

paintings (geometric motifs, red bands, red wash) and/or an applied, incised or impressed decoration. Some very rare vessels have a black slip which has been polished. Vessels without decoration are rare. Clay material colour varies. In this regard, the group of higher-quality vessels is as heterogeneous as the A2 group.

The higher-quality group includes bowls, basins, holemouth jars, jars and churns. Within each category types are varied in terms of the profile of the walls and the rims (Table 9.3). Vessels A3 are distributed in the different levels of Phase II.

Vessels B

Vessels B (Figure 9.4) are very much in the minority, representing less than 10% of our corpus (Table 9.2). They include different technical groups: two are defined on the basis of the use of the rotary movement for shaping the rim and/or the upper part of the vessels.

VESSELS B1

Vessels B1 have been regularized on humid clay with the help of a rotary movement. Unlike vessels A, the B vessels have a clay body that is quite fine, with a low quantity of coarse fraction. Vessels B1 includes vessels with and without decoration. Those with decoration present a red

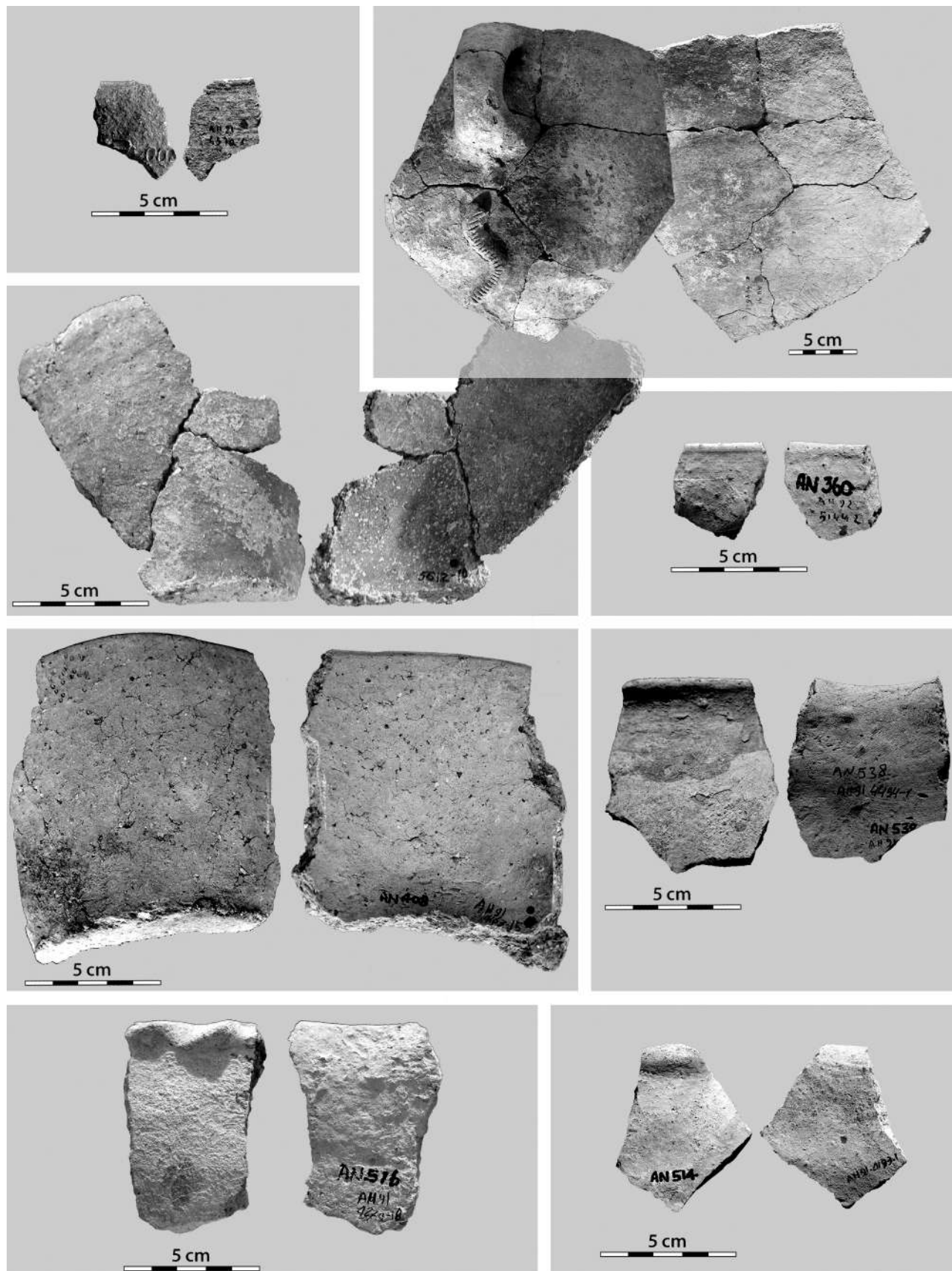


Figure 9.2 Medium quality vessels – A2

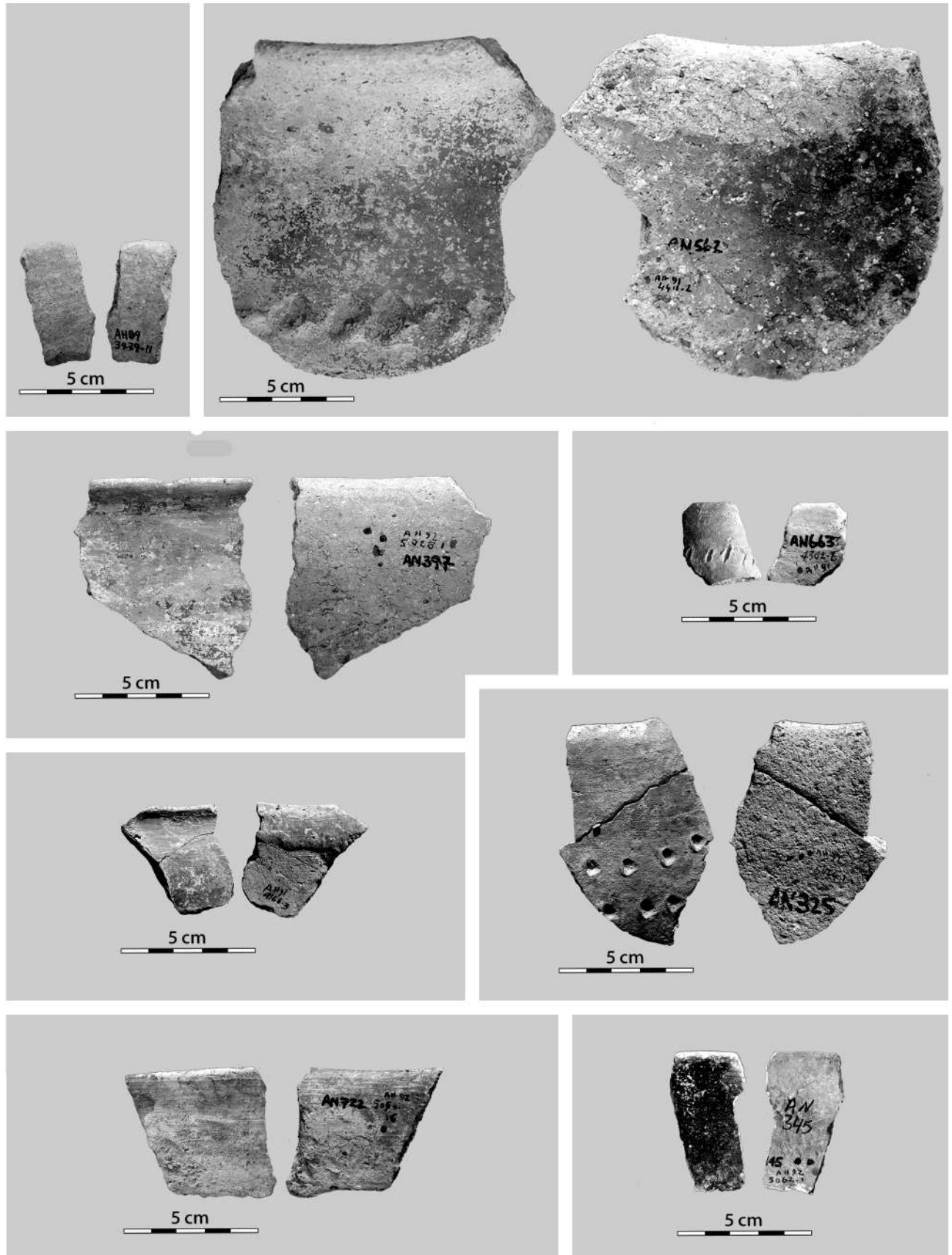


Figure 9.3 Higher quality vessels – A3

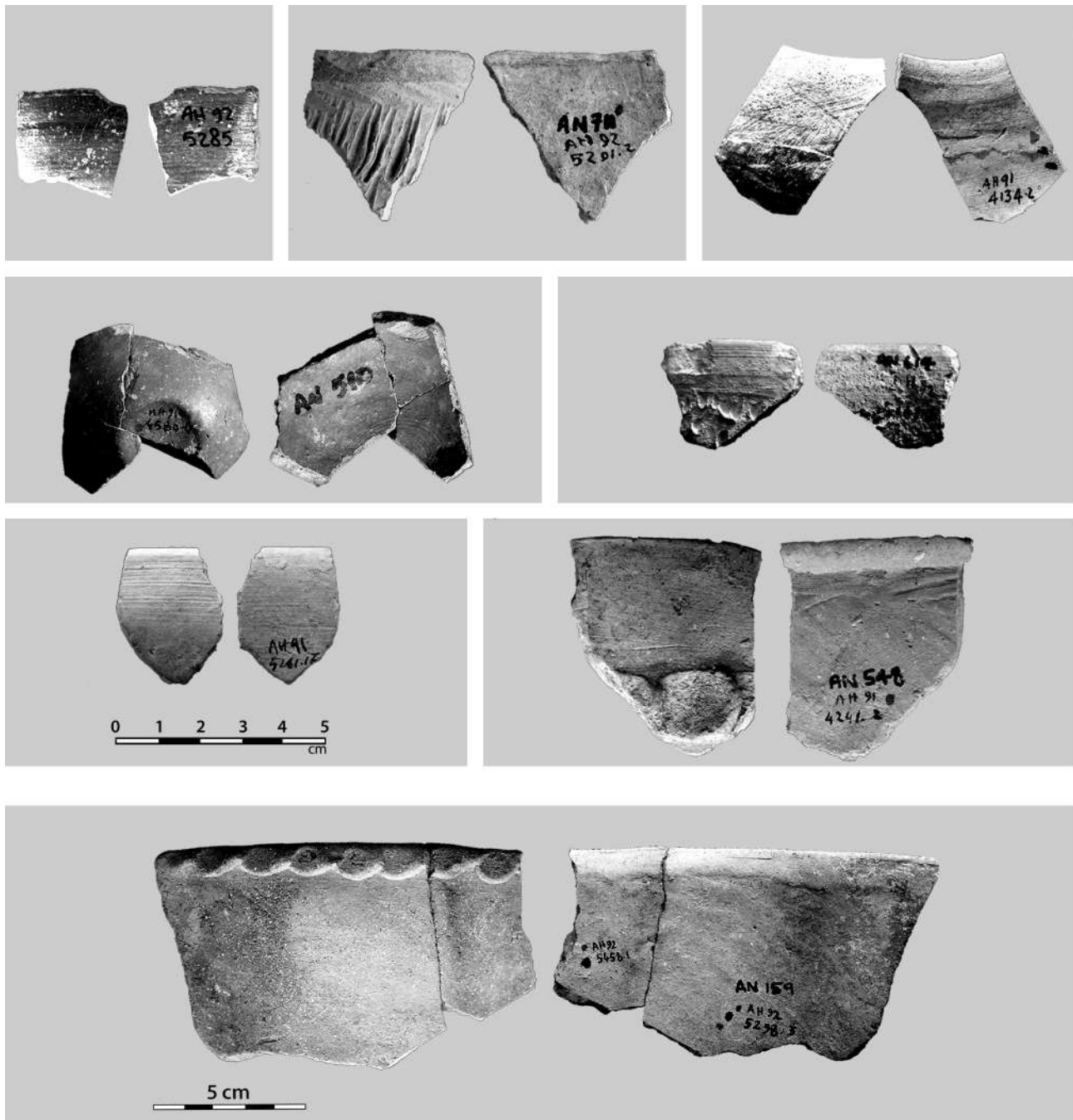


Figure 9.4 Vessels B

slip, one vessel displaying a burnished red slip. One vessel, without slip, presents an impressed decoration.

Vessels *B1* are mainly bowls, and also small holemouth jars, as exemplified by one specimen. They are found in levels 3a and 3b, which indicates that, in the southern Levant, the use of the rotary movement for regularizing rims and/or the upper part of vessels dates back to at least the first half of the 5th millennium cal BC.

VESSELS *B2*

Vessels *B2* are characterized by clay walls whose surface

aspect is not lumpy, but smooth and evened. This group is not homogeneous and presents high variability in terms of the smoothing gestures and tools and the decoration operations (red slip, burnishing, impressed or appliqué decoration). One should distinguish between the small vessels (bowls) with a red burnished slip and the vessels including small and large open vessels (bowls and basins) with or without decoration, which includes rims with a red band along with a vertical incised decoration on the body, rims with a thumb-print decoration, and thumb-print bands applied on the body. Vessels *B2* are distributed in the different levels of Phase II (3a, b, c).

Petrographic analysis: general classification of clay sources

At first, the binocular examination shows a predominance of very fine-textured raw materials that appears to reflect the widespread availability of clay-rich flood deposits throughout the Near East in flood plains, small valleys or even depositional basins. However, upon closer inspection, the comparison of the petrography and particle size composition of the coarse components, in addition to a rough estimate of the clay mineralogy based on its colour and its textural aspect, reveals the great heterogeneity of the 5th-millennium cal BC ceramic assemblage in terms of provenance. This is more particularly reflected by the difficulty in obtaining more than a very few sherds within each petrographic class of raw materials, and even to clearly define classes of strictly identifiable raw materials. Nonetheless, it seems difficult to reconcile this variability with the widely accepted assumption that, *a priori*, a settlement ceramic assemblage comprises a majority of locally made ceramics – that is, whose clay sources are located within a 10-km radius (e.g., Arnold 1985). There are some roughly categorized classes of raw material within the assemblage which may, upon further study, allow more precise provenance. A few of them strongly resemble specific fabrics of the transitional 5th- to 4th-millennium cal BC ceramic assemblage as previously defined (Roux and Courty 2005). Their provenance can thus be suggested on the basis of results of our previous studies based on the similarities of the coarse fraction added to the clay materials; rock sources have remained unchanged from the 5th to the 4th millennium. However, this overall geological stability should not be confused with the high reactivity of soil landscapes to short-scale environmental changes, exemplified by modifications of the clay materials themselves, and to a lesser extent by morphology and abundance of the coarse fraction. By way of example, a group from Abu Hamid made with finely sorted crushed calcitic angular fragments within weakly prepared calcareous fine clay strongly resembles a distinctive clay material found at late 5th to early 4th millennium cal BC sites. This group originated in the Ajlun mountains and therefore possibly had a similar provenance in the earlier period.

Petro-technological classification

As we noted above, vessels *A* and *B* are distinct from a technological point of view but the difference in fabric is even more marked (Figures 9.5, 9.6, 9.7). Vessels *B* are dominated (>90%) by very fine clay (VFC) and sandy clay (SC) which, by contrast, are only minor components of vessels *A* (<5%). The majority of vessels *B2* (~60%) and the minority of vessels *B1* (30%) belong to the SC type (with a remarkable petrographic homogeneity and a range of particle sizes that matches low-energy flood deposits). This SC is likely to come from within the Jordan valley itself, which was, at the time, a wide, regularly flooded alluvial

plain with a meandering channel. The majority of vessels *B1* (70%) and the minority of vessels *B2* (40%) are made of very fine clay (VFC) with a significant mineralogical variability of the clay fraction and major variations in the amount and type of the coarse fraction. This reflects a great heterogeneity in terms of provenance and, in contrast, a striking homogeneity with respect to the great care in clay preparation.

As with the technological classification, the lower-quality vessels (*A1*) (Figure 9.6) appear to form a coherent petrographic group when compared with medium-quality vessels (*A2*) and higher-quality vessels (*A3*) (Figure 9.7). This coherence is expressed by the predominance of fine clay mixed with an angular, coarse fraction crushed from various types of limestones (80%), with a particular type represented by crushed pure calcite, and another one by crushed bioclasts. This petrographical range indicates multiple provenances from the plateau regions with their distinctive limestone outcrops. The medium-quality vessels (*A2*) and the higher-quality vessels (*A3*) are both characterized by heterogeneity in raw materials (expressed in terms of variability in morphology, petrography and abundance of the coarse fraction). The predominance of weakly sorted sub-rounded calcareous grains matches a provenance from the small tributaries flowing along the colluvial piedmonts on both sides of the Jordan Valley before merging into the mainstream. The lack of distinctive petrographic classes, and the overall impression of a continuum between poorly sorted to well-sorted, and well rounded to sub-angular, calcareous grains, seems to reflect the inherent variability of flood deposits along colluvial piedmonts at the meso-regional scale. This would suggest an occasional exploitation of raw materials collected from various places and not always from the same provenance.

Discussion

The techno-petrographic approach, as applied to the Phase II ceramic assemblage from Abu Hamid, enables us to highlight a large range of technological practices originating from various places and characterize the material resources used during the period prior to the Beer Sheva–Ghassulian horizon and posterior to the 6th millennium cal BC. In this respect, the techno-petrographic approach proves to be particularly relevant to the interpretation of ceramic assemblages in terms of both period and communities ('cultural groups').

Techno-stylistic variability and communities

The techno-petrographic analysis of Abu Hamid ceramics has shown that vessels can be divided into two main techno-petrographic groups, *A* and *B*.

Group *B* is very much in a minority, and is restricted to a limited range of vessels, mainly small vessels (bowls).

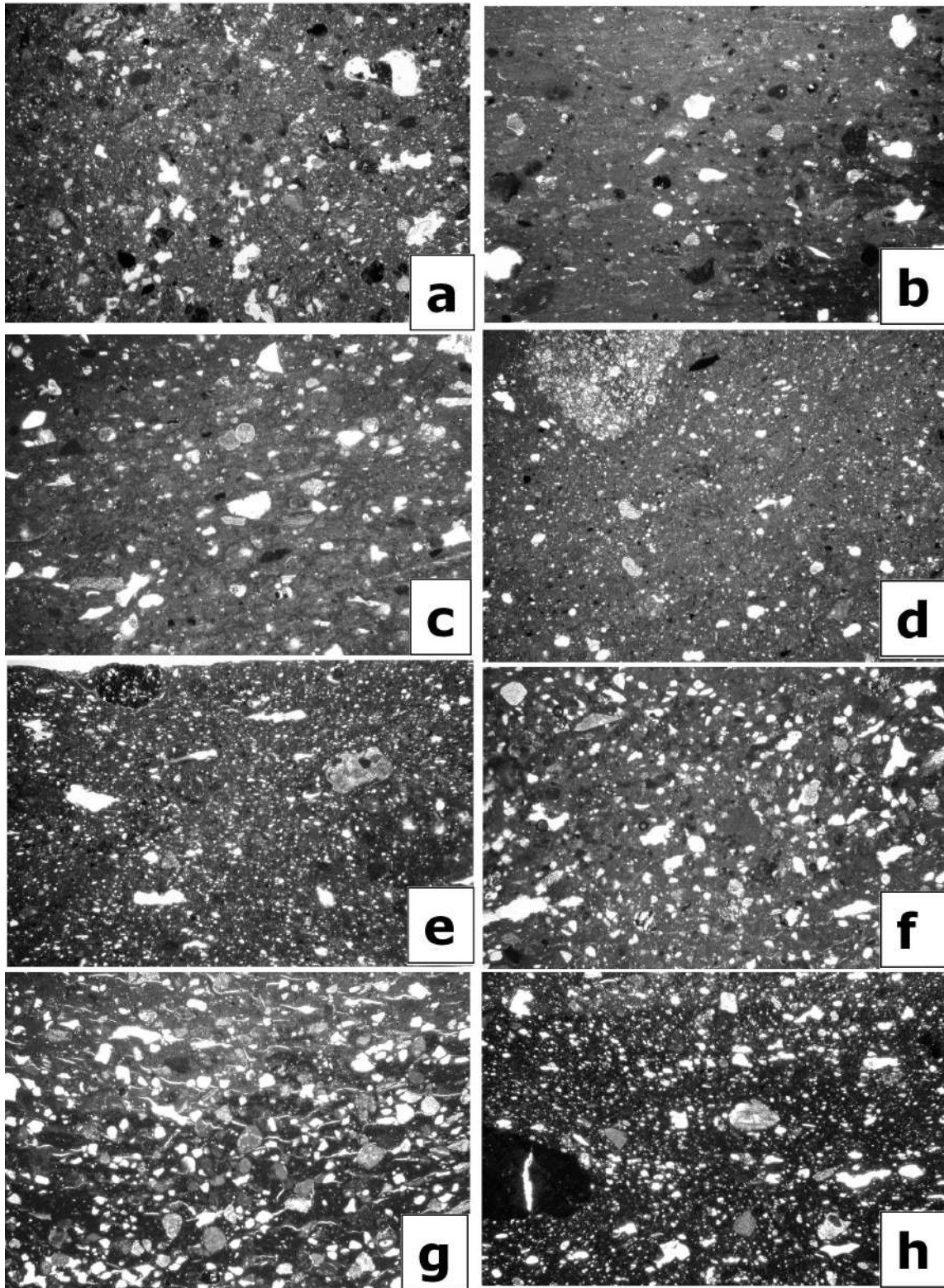


Figure 9.5 Vessels B: Illustration of the different petrofacies. Frame width for all the photos: 4 mm

(a) Yellowish-brown very fine calcareous clay with subrounded calcareous fine sands; (b) dull orange very fine calcareous clay with well-rounded calcareous fine sands; (c) pale yellow very fine calcareous clay with subangular to sub-rounded chalky fine sands; (d) pale yellow very fine calcareous clay with rare subrounded coarse clasts of chalky limestones; (e) yellowish-brown calcareous sandy clay with poorly sorted subrounded micritic fine sands; (f) yellowish-brown calcareous very fine clay with weakly sorted subrounded micritic fine sands; (g) yellowish-brown calcareous sandy clay with well-sorted well-rounded micritic fine sands of alluvial origin; (h) yellowish-brown calcareous coarse sandy clay with poorly sorted subrounded micritic fine sands

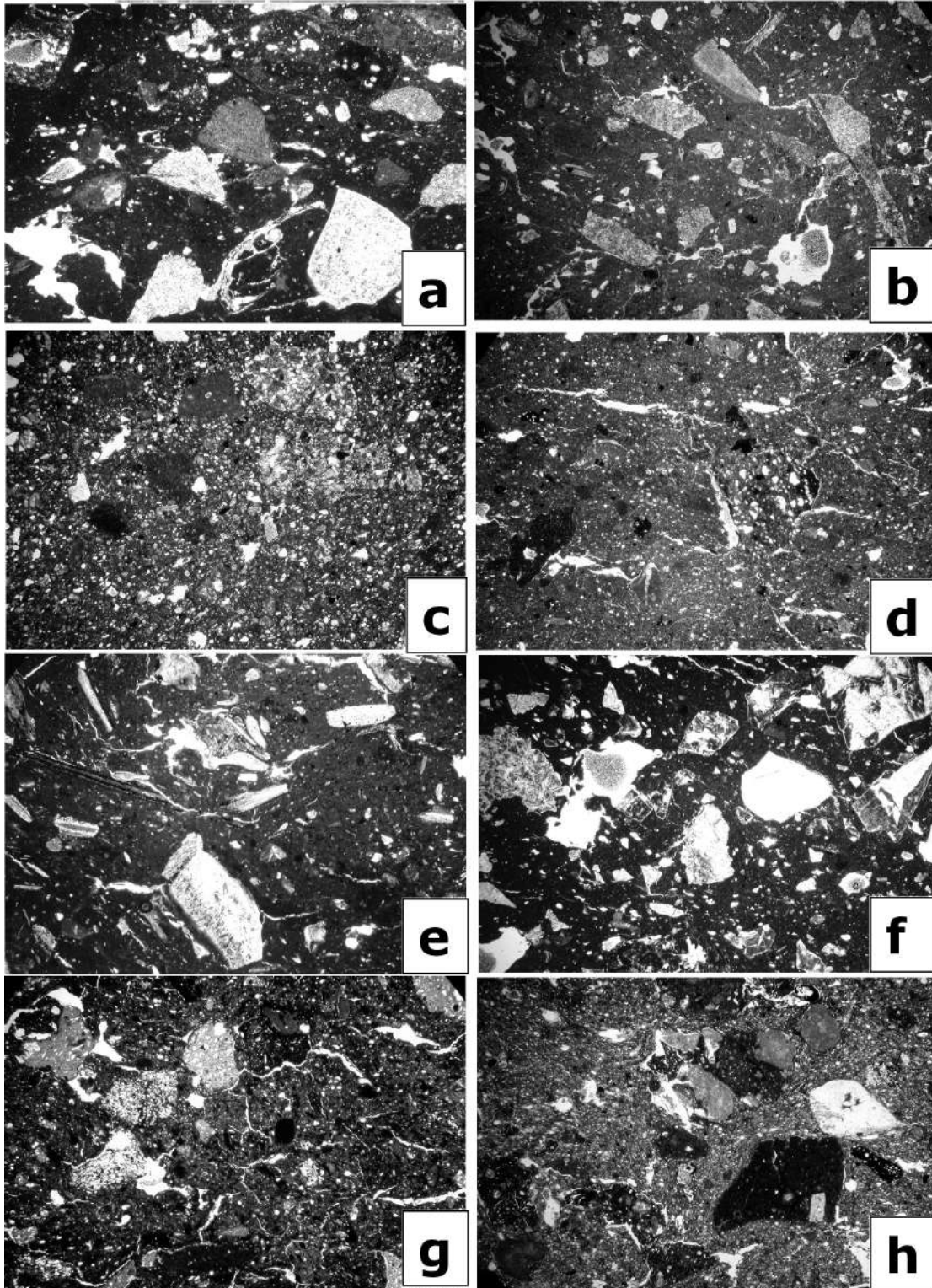


Figure 9.6 Vessels A, low quality: illustration showing the high variability of the different petrofacies derived from the plateaus. Frame width for all the photos: 5 mm

(a) Brownish-yellow calcareous clay with subangular to subrounded limestone coarse grains; (b) pale yellow fine calcareous clay with angular limestone coarse grains; (c) reddish sandy clay with poorly sorted coarse grains of micritic limestones and fine quartzitic sandstones; (d) reddish-yellow calcareous silty clay with rare subrounded soil relicts; (e) yellowish-red calcareous clay with finely crushed *Ostrea* fragments derived from fossiliferous Cenomanian marls of the Ajlun mountains; (f) brownish-yellow calcareous clay with finely crushed angular limestone coarse grains; (g) reddish-brown ferruginized sandy clay with subangular clasts (gypsum, clayey clasts, ferruginized concretions); (h) greyish-yellow deferruginized sandy clay with subangular clasts (micritic limestone, ferruginized concretions)

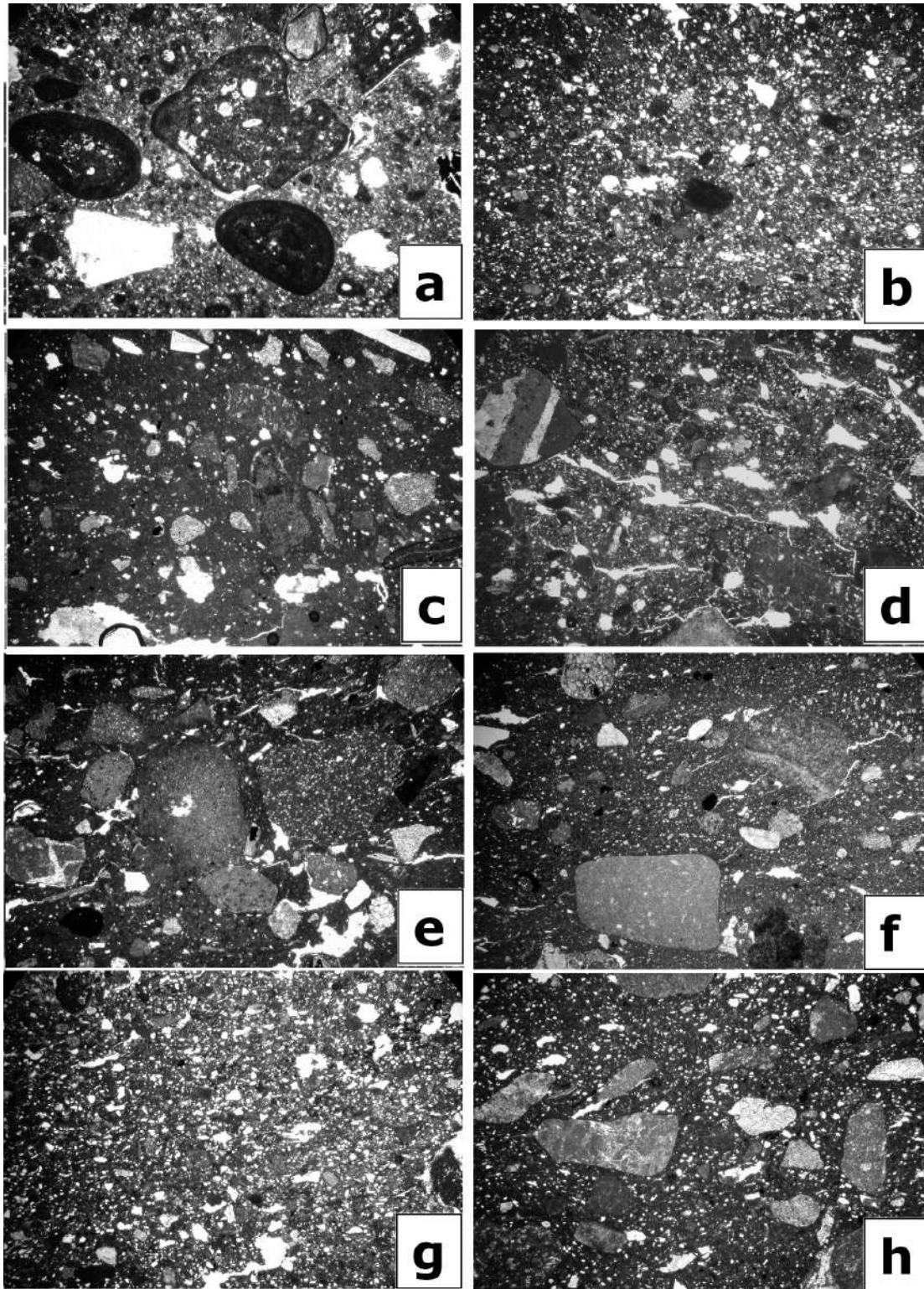


Figure 9.7 Vessels A, medium to high quality: illustration showing the wide range of petrofacies within a rather coherent group reflecting the geological homogeneity of the colluvial piedmonts at a meso-regional scale. Frame width for all the photos: 5 mm

(a) Brownish-yellow sandy clay with abundant weakly sorted subrounded coarse carbonate concretions; (b) brownish-yellow coarse sandy clay; (c) brownish-yellow very fine clay with weakly sorted subangular to subrounded, limestone coarse grains; (d) brownish-yellow clay with weakly sorted subangular to subrounded, limestone coarse grains; (e) brownish-yellow fine clay with abundant poorly sorted subrounded limestone coarse grains; (f) brownish-yellow fine clay with weakly sorted rounded limestone coarse grains; (g) brownish-yellow sandy clay with well-sorted angular micritic fine sands; (h) Reddish-brown sandy fine clay with well-sorted subrounded limestone coarse sands

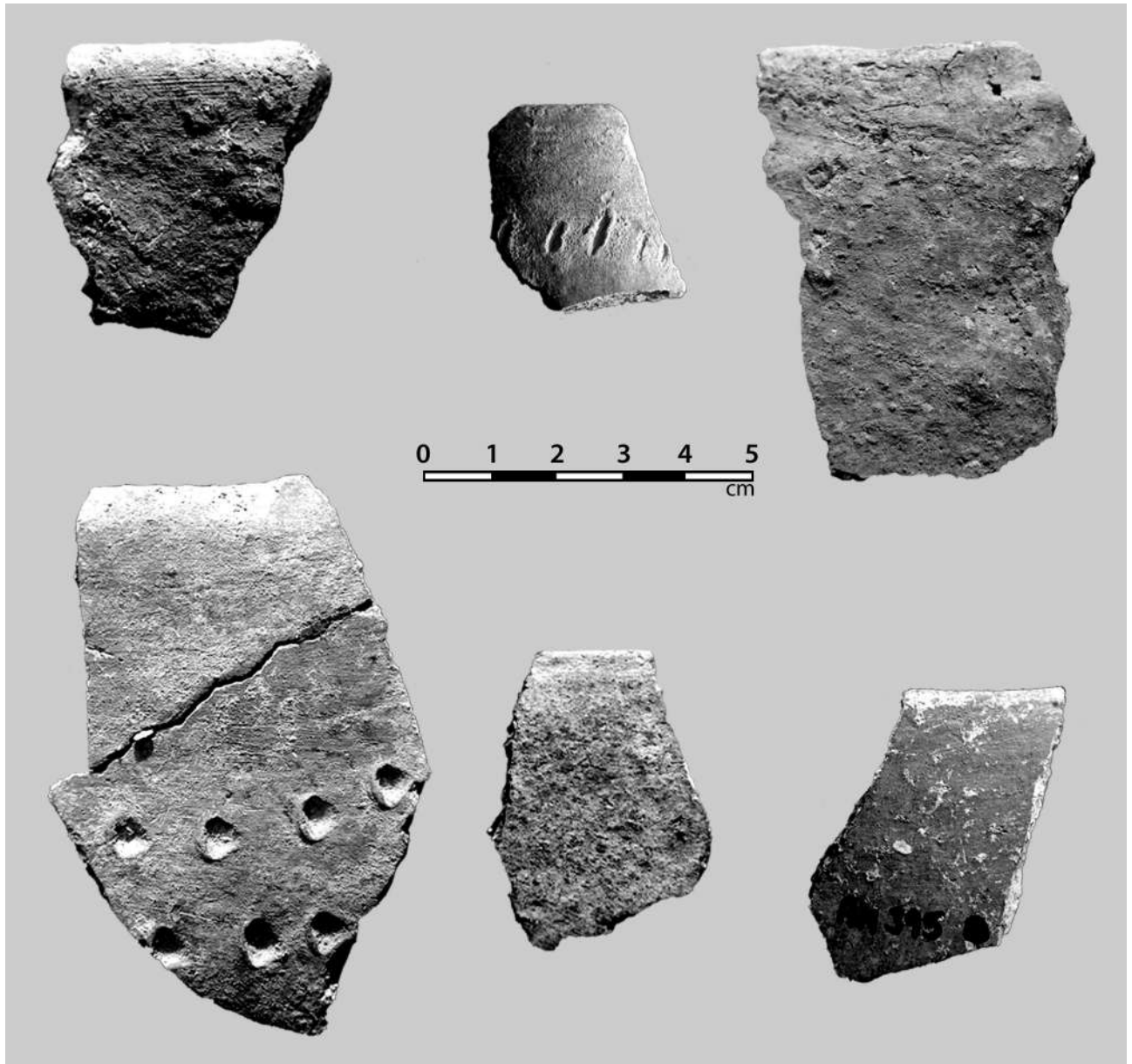


Figure 9.8 Holemouth jars, straight-sided (type D1c3): from top left, strata 3e, 3c, 3c; from bottom left, 3/4, 3b, 3a. One morphological type can include different techno-petrographic groups and, in this regard, not be indicative of the different related units of production

These few vessels present varied specific stylistic features and, in this regard, correspond to quite unique pieces. They include the ones whose rim and/or upper part have been shaped with the help of rotary movement, fine small red or black burnished slip vessels, and vessels with impressed or thumb-band decoration. They originate from the Jordan valley and elsewhere. That vessels *B* are in a strong minority, that some are finished according to a new technique (the rotary movement), and that a narrow range of morphological types, all carefully made, is presented, suggests that we are probably dealing with a production whose function (in the large sense of the word, including symbolic function) is specific, and is distinct from that of vessels *A*. In other words, the technological practices

which divide groups *B* and *A* express different functional categories, and perhaps different groups of producers.

Group *A* is in the majority. Within this group technological attributes have allowed us to distinguish three sub-groups on the basis of the degree of know-how involved, from low to high. These three groups do not correspond to a functionally diversified production; rather, each of them comprise a comparable range of morphological types (e.g., in level 3a, each technological group presents both bowls and jars) as well as same types of vessels (Figure 9.8). Moreover, they include vessels made out of clay materials whose sources are found in distinct landscapes – the Jordan plateau versus piedmonts of the Jordan valley.

The manufacture of the lower-quality vessels (*A1*)

conveys awkwardness. Such awkwardness can be interpreted as the production of unskilled potters making a few pots per year (e.g., ethnographic examples in Ali 2005). In favour of this hypothesis, the morphological data indicate that, within group *A1*, each meta-type includes a wide range of types, and each type has a strong metric variability; while ethnoarchaeological data have demonstrated that the less practice the potter has, the less standardized the vessels are (Roux 2003). In other respects, the techno-petrographic variability suggests that the potters were collecting clay in an opportunist way within a circumscribed environment, the Jordanian Plateau. It means that there was not a centre of production, but various units of production collecting clay in various places when needed. This lack of a centre of production is also supported by the technological variability characterizing the *A1* vessels. In summary, our data suggest that vessels *A1* were manufactured by various groups from the Jordanian Plateau who produced very few ceramics, probably mainly for culinary functions (as suggested by the firing traces located outside and inside the vessels). The technological similarities between the *A1* vessels suggest that these various groups were interacting at a certain level.

The medium- and higher-quality vessels *A2* and *A3* convey a better control over the manufacturing process, while their clay materials originate from different sources located in the piedmonts of the Jordan valley. This implies, firstly, that the producers of the *A2–A3* vessels had a higher rate of production and were different from the producers of the *A1* vessels. They produced a large range of functional vessels, as shown by morphological and technological features (some *A2–A3* vessels also present firing traces outside and inside the vessels, suggesting culinary functions). Secondly, techno-petrographic features suggest that *A2* and *A3* vessels were made by different communities. Indeed, technological variability is higher than within the group *A1*, in the sense that it encompasses a wider array of technical traditions, found in the surface treatment and decoration level. This variability is found throughout level 3 and cannot be correlated with any stylistic evolution over time. In addition, despite a better control over the manufacturing process and, therefore, probably, a higher rate of production, morphological and metric variability within groups *A2–A3* is as strong as that within the *A1* group. Petrographic analysis suggests a variability of the clay sources found at the level of each vessel. In this regard, the ceramic production of *A2–A3* appears as originating from different units of production distributed over a meso-region (beyond a radius of 10 km; Roux and Courty 2005), whose identities are more strongly expressed than in the case of the *A1* ceramics. Let us recall here that social interactions between master/mistress and apprentice during the pre- and post-learning process imply a certain techno-stylistic homogeneity at the settlement level as well as the continuation of a tradition over a significant period of time. This anthropological mechanism means that techno-petrographic and morpho-metrical

variability between households and between communities are of a different order of magnitude. At Abu Hamid, the variability observed not only does not correspond to the sort of variability expected between households, but in addition does not match any specific spatial distribution. Strong techno-petrographic variability is observed within the same spatial units. In this regard, it cannot be explained in terms of inter-household variability or evolution over time, whatever the bias of the sampling.

In brief, the diversity of the techno-petrographic groups characterizing Abu Hamid ceramic assemblage suggests that the latter comprises in the majority productions originating from communities moving in different geographical zones with different experiences in pottery-making, and coming over time to Abu Hamid. The local production is very much in the minority. Let us recall that during the Beer Sheva–Ghassulian period, Abu Hamid was a place where communities came from all over the southern Levant. Apparently this phenomenon existed, on a smaller scale, in the previous period, raising once again the question of the function of the site (Roux and Courty 2007). More techno-petrographic studies are now to be conducted on the sites presenting Wadi Rabah techno-complexes in order to assess if such a phenomenon could not be related as well to the high degree of mobility of these communities.

Techno-stylistic variability and cultural phase

The material resources used during Phase II reflect a particular moment in the evolution of the palaeoenvironment which is well placed in terms of relative chronology. These resources are different from the ones used during Phase I and Phase III and are distinctive, in this regard, of the early 5th millennium. The marked differences in material resources between Phase II and Phases I and III are also found at the level of the technological practice and the morphological type.

Ceramics belonging to Phase I are characterized by a higher homogeneity in terms of technical practices (Ali 2005) and morphological types (Lovell *et al.* 1997). Vessels are formed by coiling and their surface treatment is largely the same as that of the lower-quality vessels of Phase II (*A1*). Generally speaking, their manufacture is awkward and reveals a low rate of production. Morphological types consist mainly of simple, straight-sided bowls, cups with button bases, holemouths with simple or slightly bevelled rims and tall-necked jars (Lovell *et al.* 1997, 366).

By contrast, ceramics belonging to Phase III are characterized by a high level of know-how as well as a techno-petrographic diversity revealing communities originating from all over the southern Levant (Roux and Courty 2005; 2007). The technological variability observed in the ceramics belonging to Phase III is different from the diversity observed in the Phase II material: it corresponds to variants of a similar technological tradition (Roux and Courty 2005) and not to distinct technological traditions. In this regard, it expresses a certain phenomenon of

homogenization. By reference to ethnographic situations, such a phenomenon occurs when cultural groups interact with each other, the subsequent learning networks creating communities of practices and therefore the homogenization of technological traditions through the borrowing of technological traits (e.g. Livingstone Smith 2002; Gosselain 2008).

The diversity of the techno-petrographic groups of Phase II, observable in our corpus at the level of the vessel, suggests that, in the southern Levant, distinct social units were visiting Abu Hamid repeatedly, and indicates interactions between the communities living on the plateau and in the valley. Such relationships were probably part of the general evolutionary process from which the Beer Sheva–Ghassulian culture emerged. In this regard, the transitional period corresponding to Phase II can be considered as a key period, as suggested by Gilead (1990).

Such a techno-petrographic diversity might also explain why each site found on this horizon (the so-called Wadi Rabah Horizon) does not present strictly comparable ceramic assemblages (e.g., Braun 2004; Garfinkel 1992; Gopher and Gophna 1993; Lovell *et al.* 2007): each of them may originate from a variable range of communities, or may reflect different degrees of community mobility. Thus, the fact that the ceramic assemblages of a site like Tel Tsaf seem to be different from those of Abu Hamid, and are characterized in particular by specific painted ceramics (Garfinkel *et al.* 2007; Gophna and Sadeh 1988–9), is consistent with the hypothesis of a chrono-cultural period, the early 5th millennium, marked by a progressive and differential increase in ceramic production, communities and interactions whose consequence would have been a growth of technological diversity at the scale of the southern Levant.

Conclusions

The techno-petrographic approach proves particularly relevant for a description of the ceramic assemblages in terms of traditions and therefore learning networks and communities of practice. When these communities use datable material resources it enables us to characterize cultural horizons – that is, periods during which a set of communities coexisted and interacted. The relevance of the approach lies also in the integration of the technological and morpho-stylistic features. The latter are a strong expression of cultural templates or norms. Combining technological and morpho-stylistic attributes proves to be particularly useful for interpreting ceramics in socio-cultural terms.

Our techno-petrographic analysis as applied to the Abu Hamid ceramic assemblage suggests that in the early 5th millennium cal BC there was great diversity in technological practices at the meso-regional scale. This diversity is in fact characteristic of the transitional period prior to the Beer Sheva–Ghassulian culture and reflects

the diversity of the communities of the time. The traces of disparate communities on the one site suggest interactions which presage the Beer Sheva–Ghassulian culture. More techno-petrographic data are required to better define the 5th millennium cal BC cultural landscape and, by extension, the function of each site at a macro-regional scale.

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